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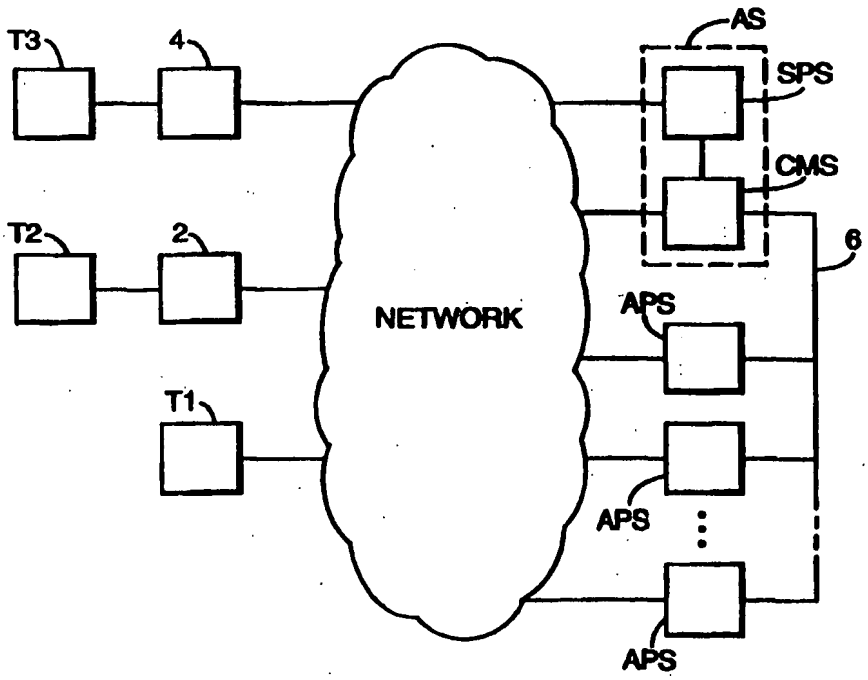
(57) Abstract

An authentication server is provided which stores authentication details of authorised users, and a list of currently-authenticated users. A number of application servers are connected to the authentication server, to allow the application servers to check the current authentication status of a user which requests service by the application servers. A session key is generated during the authentication procedure, for use during subsequent communications. One embodiment of application server which is adapted for use in combination with the authentication server is a file transfer server which allows authenticated users to upload files using a first session key generated during authentication of the sending user, and which allows a recipient to retrieve the file in encrypted form using a second session key which is generated during the authentication of the second user. The file transfer server also allows a file sender to specify a release date for data transmitted to the server. In one embodiment, the transmitted file is doubly encrypted using not only the session key of the recipient, but also an encryption key which is released to the recipient only after the specified date and time. In another embodiment, the file is stored on the server until such time as the specified date and time have passed, before being released to the recipient.



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DATA COMMUNICATIONS

This invention relates to data communications, and in particular, but not exclusively, to the communication of data via a public data communications network such as the Internet.

Due to the inherently insecure nature of data communications via the Internet, and due to the sensitive nature of some information which is transmitted, various proposals have been made for the encryption of data for transmission. Thus, although third parties may be able to intercept messages, third parties will only be able to read the data within the message if they are able to decrypt the message using an appropriate encryption key.

In public-key cryptography, such as that used in the RSA cryptography system, each person who is to receive encrypted data has a public key which is made available to anyone wishing to send that person data, and a private key which remains confidential. Data encrypted with the public key can only be decrypted with their private key. This system suffers drawbacks in that, in order to send another party an encrypted message, the sending party must know the public key of the receiving party. Also, the authenticity of the sending party cannot readily be identified since the public key is, by definition, available to any other party.

Another type of encryption system is secret-key cryptography, also referred to as symmetric cryptography. In secret-key cryptography, the sending party and the receiving party share a common secret encryption key, which is used both to encrypt data before transmission, and to decrypt the data after reception. One drawback of this system is that the two parties must, before transmission of the encrypted data, have agreed upon the shared secret key to be used.

A further problem encountered in communications over the Internet is

that of the authentication of a user. When a user contacts an Internet resource via the Internet, in many cases the resource will not be provided unless the third party has been authenticated. A common means of authenticating users is by requesting the input of a previously-established password by the user, which is then checked by the resource to confirm the identity of the user. This password-based authentication procedure can be time-consuming to the user when the user wishes to have access to a number of resources.

It would be desirable to provide improved methods, and means, for the transmission of data via the Internet, and for the authentication of Internet users.

In accordance with one aspect of the invention there is provided a method of authenticating users for access via remote terminals to a plurality of application servers, said method comprising the steps of:

storing authentication details of authorised users;

performing remote authentication of users with reference to said stored authentication details;

storing data identifying users which are currently authenticated; and

allowing said plurality of application servers to access said data identifying currently authenticated users to check an authentication status of a user.

This aspect of the invention provides for the authentification of a user over the Internet using a single authentication facility, which maintains the authentication status of users in the system. When a user wishes to access any of the application servers they may each contact the central facility to confirm the authentication status of that user, without needing to perform separate authentication procedures directly with the user.

In accordance with a further aspect of the invention there is provided a method of transferring a file between a user at a first client terminal and a

user at a second client terminal over the Internet, said method comprising the steps of:

establishing a first session key by communicating with said first client terminal over the Internet;

receiving the file encrypted with the first session key from the first client terminal over the Internet;

decrypting the file using the first session key;

establishing a second session key by communicating with said second client terminal over the Internet;

encrypting the file using the second session key; and

transmitting the file encrypted with the second session key to the second client terminal.

This aspect of the invention provides a file transferral method whereby a file may be securely transferred from a first user to a second user, without requiring the first or second users to perform any direct communications between their respective client terminals. Instead, the encryption system may be supervised by a "trusted third party", which separately generates session keys for communications with each of the first and second users respectively.

In accordance with a further aspect of the invention there is provided a method of transferring a file from a first client terminal to a second client terminal, said method comprising the steps of:

holding file transfer parameters for a plurality of different file transfer types;

transmitting data relating to at least one of said different file transfer types to said first client terminal;

receiving said file from said first client terminal;

receiving data identifying a selected file transfer type from said first client terminal; and

transmitting said file to said second client terminal in accordance with the file transfer parameters stored for said selected transfer type.

This aspect of the invention allows file transfers to be configured without requiring the file transfer parameters to be individually set up by the user at the first client terminal.

In accordance with a further aspect of the invention there is provided an application server for transferring data from a first client terminal to a second client terminal, said application server comprising means for receiving said data from said first client terminal, means for receiving a delay period indicator for said data from said first client terminal, and means for transmitting said data to said second client terminal such that said data can only be read by a user at said second client terminal after expiry of said delay period.

This aspect of the invention provides a new data transmission service which may be implemented over the Internet. Rather than waiting until a desired time to transmit the data to an application server, the first client terminal can specify the date and time for release of the data to the second client terminal when transferring the data to the application server, knowing that the data will not be released until the specified date and time.

Further features and advantages of the present invention in its various aspects will be appreciated from the following description, referring to the accompanying drawings wherein:

Figure 1 is a block diagram schematically illustrating a data transmission arrangement in accordance with the present invention;

Figure 2 is a block diagram schematically illustrating the client/server communications between a client terminal and servers provided in accordance with the present invention;

Figure 3 is a flow diagram illustrating an authentication procedure;

Figure 4 is a block diagram schematically illustrating an authentication response, and session key, generating algorithm;

Figure 5 is a flow diagram illustrating procedures carried out by a server maintaining an updated list of user authentication statuses;

Figure 6 is a flow diagram illustrating further updating procedures carried out by the server maintaining a list of currently authenticated users;

Figure 7 is a flow diagram of authentication procedures carried out by an application server in accordance with a further embodiment of the invention;

Figure 8 is a flow diagram illustrating an authentication status update procedure;

Figure 9 is a block diagram schematically illustrating a file transfer system in accordance with an embodiment of the invention;

Figure 10 is a flow diagram illustrating procedures carried out by a file transfer server;

Figures 11, 12, 13, 15 and 16 are event sequences illustrating client/ server communications;

Figure 14 is a block diagram illustrating a data transmission block in accordance with an embodiment of the invention; and

Figure 17 is a block diagram illustrating a system for transferring e-mails in accordance with an embodiment of the invention.

Figure 1 is a block diagram illustrating a data processing system in accordance with an embodiment of the present invention. The system consists of an authentication server (AS), consisting of a secure password server (SPS) and a cache management server (CMS), and a plurality of application servers (APSs). Three different classes of user terminals T1, T2, T3 are connected to the system via a data communications network, in this embodiment the Internet.

The first is a terminal T1 having a unique IP address, and which can both open a TCP/IP connection and accept TCP/IP connection opening requests over the Internet. The second is a terminal T2 which has a unique IP address, which can open TCP/IP connections, but which cannot accept TCP/IP connection opening requests over the Internet, for example due to the presence of a fire wall 2 which the terminal T2 lies behind. The third is a terminal T3 which has no unique IP address, for example due to the use of a proxy server 4 through which the terminal T3 accesses the Internet. Communications over the Internet contain the IP address of the proxy server 4, rather than that of the terminal T3.

The application servers APS which are serviced by the authentication server are remotely connected to the CMS via secure communications links 6 (which may be separate physical links, or logical links which use secure encryption during communications), or are co-located with the authentication server.

Each of the servers illustrated in Figure 1 may be implemented on a computing resource, such as a work station computer. Each of the access terminals may be implemented in the form of a work station computer, a net computer, a mobile communications terminal, etc.

Figure 2 is a block diagram illustrating the data communications which occur when a user wishes to access one of the application servers APS. The terminal contains software applications which include an authentication client (AC) consisting of a secure password client (SPC) which communicates with the SPS over the Internet using TCP/IP, and a cache management server client (CMSC), which communications with the CMS over the Internet using TCP/IP. The terminal also includes at least one application client (APC) which communicates with the application servers APS using TCP/IP or UDP/IP.

The SPS has an associated data store 8 which holds authentication details for each of the users authorised to have access to the application servers APS and a token identifying the access rights of each user. The CMS has an associated data store 10, which holds details of users currently logged on for access to the application server APS, and which maintains logging on histories for users once they are logged off.

Figure 2 illustrates the essential connections made when a user attempts to access one or more of the application servers APS. Communications between the SPC and SPS concern password-based authentication procedures. Communications between the CMSC and the CMS provide a mechanism for ensuring that a user remains logged on to the system when active, and for logging off a user when the user has become inactive. Communications between the APC and the APS provide the resources which the user wishes to access. The APS may be a WorldWide Web (WWW) server, in which case the application client is a WWW-enabled browser, such as Netscape Navigator (trade mark) and Microsoft Internet Explorer, using the Hyper Text Transfer Protocol (HTTP) specification to retrieve documents from the application server. Alternatively, the application server APS may be a server providing documents using the file transfer protocol (FTP), in which case the application client APC is an FTP-enabled client. However, the application servers APS may be any type of Internet resource server, and the terminals T1, T2 are preferably provided with corresponding types of application clients such that a user may access any of the available application servers APS from that terminal.

As will be discussed in greater detail below, the authentication procedure followed by the SPC and the SPS also provides a session key for use by the application client/application server combination during the course of the session following log on. This will be explained in greater detail below.

Next, the authentication of a user at a terminal of the class T1 or T2, and subsequent access by the user to one or more of the application servers APS will be described.

Figure 3 shows the log on procedure sequence followed by the SPS during logging on of a user from either of terminal T1 or T2. When a user at a terminal having a unique IP address wishes to access any of the application servers APS, they must complete a secure challenge-response log on process using the SPC. To initiate the log on process, the SPC opens a connection to the SPS, to which the SPS sends an acceptance greeting, step 20. This may be followed by a short query sequence during which the SPC sends a message to the SPS indicating the authentication protocol it intends to use, and the cryptographic code used by the SPC. If the SPS does not support the protocol or the code, the SPS will close the connection.

The SPC initiates the log on process, by sending the log on request and the user name input by the user at the terminal, step 22.

To authenticate the user, a challenge/response dialogue occurs between the SPC and the SPS, step 24. The SPS generates a challenge which is sent to the SPC. The challenge consists of a random sequence of bytes generated by the SPC using a cryptographically secure random number generator, (i.e. one of which the output is extremely difficult to predict), which is sent as part of a "challenge" message to the SPC.

At this stage, both the SPC and the SPS perform the algorithm illustrated in Figure 4 which generates both a response to the challenge and a session key which may be used to encrypt and decrypt data sent to the terminal during the remainder of the session. The response and session key generation algorithm involves the hash functions H0, H1 and H2. Each of these is a one-way hash function, H(M), which operates on an arbitrary length message M and returns a fixed length hash h (often referred to as a "fingerprint" or

"message digest" of message M). To guarantee security, the one-way hash functions have the following properties:

1) given M, it is easy to compute h;

2) given h, it is extremely difficult to compute or find M such that H(M) = h; and

3) given M, it is extremely difficult to compute or find another message, M' such that H(M') = h.

On the client side, the user name and password are input by the user into the terminal, and the SPC combines the two and performs the hash function H0 to produce a first hash. The first hash is combined with the challenge received by the SPC from the SPS and input to a second hash function H1 to produce a second hash. The second hash is stored by the SPC for use as the session key to be used in secure communications during the remainder of the sessions. The second hash is also combined with the first hash and input into the third hash function, H2, to produce a third hash. The third hash is returned to the SPS in a response message as the response to the challenge.

The SPS database 8 contains, against each user name entry, the first hash produced by the operation of the hash function H0 on the user name and password. The password is thus stored in hashed format, rather than in plaintext, on the SPS database 8, to protect the password from parties who may have access to the database 8. On issuing the challenge, the SPS performs the algorithm shown in Figure 4, to produce the session key and to compute the response which is expected from the SPC. If the response received from the SPC matches that computed independently by the SPS the challenge/response procedure is successfully completed. However, if the correct response is not received, the SPS will allow the user a retry, step 26. Once a certain number of retries have failed (e.g. 3), the SPS sends the SPC

an error message, step 28, and closes the connection with the SPC, step 30.

Notably, by use of the challenge/response sequence described, a session key, being a secret which is shared between the SPC and the SPS is generated without once sending the session key across the Internet.

In the next step of the log on procedure, the SPC sends a message to the SPS indicating the versions of the configuration files of software installed, which describes the name and version number of the operating system (DOS, Windows, MacIntosh, Acorn RISC OS etc), and the files which the SPC and CMSC contain. If the files are not up to date, the SPS transmits the latest versions to the SPC. These files may be encrypted with the session key generated in step 24, which the SPC decrypts and stores.

The session key generated during the challenge/response dialogue is an encryption key used in a symmetric block encryption algorithm, such as IDEA, or DES. The algorithm performs block by block encryption and decryption on the fly. In this embodiment, the algorithm uses a 64-bit block cipher although other block lengths may be used for stronger or weaker encryption as desired. A checksum is added and encrypted, to allow checking of data to be performed on the SPC side and to allow the SPC to request retransmission of blocks in which an error has been found. The authentication details stored in the SPS database 8 may include an expiry date for the validity of the password used by the user during authentication. If so, and the password has expired, the SPS initiates a forced password change, step 34, using password change procedures to be described below before the log on details are passed on to the CMS.

Once the user has been authenticated, the CMS receives a log on notification from the SPS. In addition to the authentication details, the SPS database 8 stores the session key generated during authentication and a token identifying the access rights against each user name, which are also passed on

to the CMS upon log on.

As explained above, the CMS manages a cache 10 holding the details of all users which are currently logged on to the system. The details passed from the SPS to the CMS in the log on notification include a unique identifier for the user, the hash (produced by H0) of the user name and password, the session key generated during authentication, the access rights token of the user and the current IP address of the user.

The CMS checks the number of users concurrently logged on having the same user identifier. If this exceeds a preset concurrency limit (for example once, to ensure that only one instance of a given user is logged on at any one time), and if the concurrency limit is exceeded, an error message is sent to inform the user that they will not be logged on, step 28, and the connection is closed, step 30. Otherwise, the user is accepted as logged on by the CMS, and the SPC sends a "message of the day", step 36, and closes the connection, step 30.

At this point, the user is fully logged on in a CMS, with the log on notification details stored in the CMS store 10. The user may then, via an appropriate application client APC access one ore more of the application servers APS which the user is authorised to access, as specified by the access right token.

When the application client APC sends an access request to an application server, as shown in Figure 2, the request contains the unique IP address of the user terminal, T1 or T2. The application server APS then sends a log on check to the CMS, via the secure link 6, including the IP address of the user.

The CMS checks whether that IP address is present in the stored list of currently logged on users. If so, it checks the access rights token stored against the same user, and if the user at that IP address is both currently

logged on and has access rights to the application server in question, the CMS returns an access allowed message to the application server. Otherwise, the application server APS receives an access denied message from the CMS and, if the application client has requested a connection, the application server refuses the connection, or if the application client AC has requested a document to be sent, the application server does not send the requested document.

Once a user is logged on to the system via the SPS, the CMS performs a periodic check that the user remains logged on, using a challenge/response procedure similar to that used during the initial authentication of the user. The procedure used by the CMS will depend on the type of terminal at which the user is logged on, in particular whether the CMS is able to contact the terminal to open a connection with it over the Internet (which is not possible for terminals of the class T2).

Once a user is logged on to the system via the SPC, the user may initiate a password change, or a log off request using the SPC. If the user wishes to log off, the SPC sends a log off request to the SPS, step 38, to which the SPS responds by sending a log off notification to the CMS, which will then remove the user from the list of logged on users. The CMS also updates the log on history for the user, storing the log on time, for billing purposes.

If the user wishes to change their password, or the user is forced to change their password, the SPC prompts the user to enter a new password, which the SPC combines with the user name and performs the hash function H0 to produce the first hash of the hash in algorithm shown in Figure 4. This hash of the user name and password is then encrypted with the session key generated during authentication and sent to the SPS. The SPS decrypts the hash and stores it in the SPS database 8.

Notably, the new password is sent in hashed form and encrypted, to avoid the password being read at any stage during the password change procedure, step 42.

The SPS then initiates a challenge/response procedure as described above, to re-authenticate the user, step 44. If an incorrect response is received by the SPS, the user is logged off, step 40, and the log on history of the user is updated. If the correct response is received, the log on status of the user is updated in the CMS, step 46, and the connection is closed, step 30.

With terminals of the type T1, which will allow a connection to be opened by the CMS over the Internet, a procedure as shown in Figure 5 is followed by the CMS after log on.

When a user is first logged on, or when the CMS receives a log on update from the SPS, the CMS initiates a timer for that user, which operates to ensure that users are logged off after a period of inactivity, for example 5 minutes. After the timer is initiated in step 48, if the timer times out, or when a high value service is requested from one of the application servers APS, the CMS opens a connection with the CMSC, step 50. The CMSC then initiates the challenge/response procedure using a new randomly-generated challenge, step 52. The response by the CMSC is computed by the SPC.

If the response returned by the CMSC matches that computed by the server, then the CMS resets the user's timer, step 54, and closes the connection, step 56. The encryption key generated during the calculation of this response is discarded, so that the session key generated during the initial authentication procedure, or the key generated during the password change procedure, is maintained for encryption purposes.

If the response returned by the CMSC does not match that computed by the server, then the user is logged off the CMS, step 58, the log on history of the user is updated, and the connection is closed, step 60.

The CMS is also able to send commands to users at terminals of the class T1. To send a command, the CMS opens a connection with the CMSC, step 62, and performs a command sequence, step 64, before closing the connection, step 66. Various command sequences are provided for. The CMS may request a file from the SPC, by sending a "send file" command, which includes the name of the file to be sent. The SPC then sends the original size of the file, the total number of bytes that will be sent, and the encrypted contents of the file to the CMS. The CMS may also download files to the CMSC, with a "receive file" command which includes the file name to be sent. The CMSC displays a file browser to the user to allow the destination of the file to be chosen and to change the name of the file. The CMS then sends the content of the file in encrypted form.

The CMS may also retrieve a list of files and directories in a given directory from the CMSC. Once the CMS has opened a connection, a "get directory" command is sent, including the name of the directory to be retrieved. The CMSC then sends a list of files and sub-directories in that directory.

The CMS may also send a message to the SPC containing the initial password of a new user. When a new user account is created in the SPS, the CMS opens a connection and sends the new password, which is randomly generated, in encrypted form to maintain the security of the system.

Where no connection opening path exists from the CMS to the CMSC, as in the case of the class of terminals T2, a procedure as illustrated in Figure 6 is followed to update the log on status of the users in the list of logged on users in the CMS. When a user is initially logged on in the CMS, or when a log on update is received from the SPS, the CMSC initiates a timer allocated to the user, step 68. In order to maintain the log on status of its user, the CMSC periodically contacts the CMS, with a frequency somewhat greater than

the frequency of time-out of the user's timer, to perform the updating. The CMS then accepts the connection opening request from the CMSC, step 70, and initiates a challenge/response procedure similar to that used in the initial authentication process, step 72. If the correct response is received, the user's timer is reset, step 74, the connection is closed, step 76, and the encryption generated during the challenge/response procedure is discarded.

If however no challenge request is received from the CMSC within the time-out period, the CMS acts to log off the user, step 78, and updates the user's log on history. Once logged off, the user can no longer access any of the application servers AS of the system.

The authentication scheme described in relation to users at terminals T1 or T2 described above involves identification of a user, after initial authentication, by the IP address of the terminal at which the user is logged on. Because the CMS performs periodic re-authentication of the user, it is difficult for a third party to impersonate the user by IP address spoofing. Namely, even if a third party were to spoof the IP address of the user, the third party would only have access to the real user's resources for the time provided by the user's timer in the CMS. Once the timer has expired, the third party forming the IP spoofing would not be able to re-authenticate, without access to the user's password. Since the user's password is only ever sent across the Internet when a password change occurs, and even then in encrypted form, a third party has no means of finding out the password of an authorised user.

Since the class of terminals T3 individually have no unique IP address, a different authentication scheme is provided, as illustrated in Figure 7. A user at a terminal T3 logs on to the system via an application server APS. In the following, the application server exemplified is a WWW server, using HTTP to format communications with the application client APC. However,

it will be appreciated that a similar authentication scheme may be implemented in other types of network server, using different network communications protocols.

The application client APC in this case is a WWW browser, such as a Netscape Navigator, or Microsoft Internet Explorer (Trade Marks) browser. In order to access the application server, the application client sends a request for a document over the Internet. In order to identify and locate a document in any WWW server, files are identified by a universal resource locater (URL). The URL is structured to identify the service protocol (which in this case is HTTP), the "domain" of the Internet server, the directory of the file in the Internet server, and the file name. The URL structure is as follows:

HTTP: //domain/directory/file name.

This authentication scheme uses the functionality of packets of information sometimes referred to as "client-side persistent information" but more commonly referred to as "cookies". Cookies may be sent from a WWW server, embedded in a document sent on request by that server. On receiving a cookie, the browser automatically stores the information in the cookie, and automatically transmits the information in a document request whenever the browser is attempting to retrieve a document from a server in the same domain as the server from which it received the original cookie. Cookies are referred to as "client-side persistent information". The application client APC used in the present embodiment is a browser which supports cookies, such as those mentioned above.

In this case, since the user has no unique IP address, the application server sends the application client APC a cookie containing an identifying tag for the user, referred to herein as an address token since it replaces the IP address as the means for identifying the user, which consists of a large random number. The application client APC stores the cookie and prompts the user

to enter their user name and password, on which the SPC performs the first hashing function H0 illustrated in Figure 4. The application client APC then returns the address token along with the hash of the user name and password, whereby the application server APS performs authentication of the user via the CMS and SPS.

Figure 7 shows the event sequence in terms of actions taken by the application server APC during authentication of a user based at terminal T3. When the application server APS receives a document request, step 80, the APS checks whether the request contains an address token as a result of a cookie previously being sent to the application client APC. If the document request contains no such address token, the application server sends the APC a cookie containing a newly generated address token, which the APS also stores as an as yet invalidated address token, step 82.

In return, the APS receives the authentication details from the APC, step 84, including the same address token, whereby the user is re-identified, and the hash of the user name and password. This information is passed on to the CMS, which polls the SPS to check whether the user name and password hash matches one stored in the SPS store 8 as that of an authorised user.

If the hash returned by the APC is one of a valid user, and if no concurrency limits are exceeded on the number of users having the same user identification in the CMS store 10, the CMS retrieves the user's access rights token from the SPS store 8. If the access rights token then indicates that the user is allowed access to the application server to which the log on attempt is being directed, the CMS sends an access allowed message to the APS, and stores the address token of the user and the access rights token in the CMS store 10. On receiving the access allowed message, the application server sends the requested document, step 86.

If however the CMS, on checking the details in the SPS, determines that the authentication details supplied by the user are invalid, step 88, the APS receives an access denied message and generates a new address token and sends a new cookie to the application client. The new address token contains a flag indicating that the user has failed already once to provide correct authentication details, which flag is incremented each time the user fails to authenticate. Once the user has failed three times to authenticate, the APS sends an error message to the APC, indicating that the user will not be logged on, step 90.

If the CMS determines from the access rights token received from the SPS database 8 that the user is not entitled to access the application server to which the access attempt is being directed, step 92, the application server sends an access denied message to the application client indicating that the user is not entitled to log on to that particular APS, step 94.

Figure 8 illustrates the procedure followed by the CMS in order to update the current log on status of a user accessing via the terminal T3. When the user initially logs on, the CMS initiates the user's timer, step 96, which is set to log off the user after a set period of inactivity, for example 5 minutes. If during that time, the CMS receives a log on check from any of the application servers APS, due to a request of resources from the user, the CMS both confirms to the APS that the user is logged on, identifying the user by means of the address token sent to the terminal when the user is initially logged on, and resets the timer, step 98. After the period of set inactivity, the timer times out and the user is removed from the stored list of currently authenticated users by the CMS, step 100. As the user is logged off, the CMS updates the log on history of the user, for billing purposes.

Since the functionality of sending cookies at present is such that a browser will send information containing a cookie to any of the application

servers within the same domain as an application server which initially supplied the cookie, the application servers of the present embodiment are preferably located in a common Internet domain. However, a similar functionality could be provided by servers in multiple domains, by arranging the application client such that the details in a cookie are sent to any of the application servers within the system, or by sending multiple cookies for application servers in different domains.

Figure 9 illustrates a particular embodiment of application server, referred to as a secure file transfer server (SFTS), which may be used in the system of the present invention to transfer files between a first client terminal 102 and a second client terminal 104.

Each of the client terminals 102, 104 are of the terminal class T1 or T2. During log-on to the system using the described interactions between their respective authentication clients AC and the authentication server AS of the system, a session key is generated which is used for encryption and decryption of files which are to be transferred between the client terminals 102, 104 and the security server 106. In this embodiment, the client terminals 102 and 104 each include two application clients, namely a file/mail sender client (FSC) and a file/mail receiver client (FRC). Encryption/decryption of files takes place in a security layer (SL) using the session key stored in the authentication client AC after log-on of the user.

The SFTS interrogates the authentication server AS whenever service is requested from either of the client terminals 102, 104, to check that the user at the terminal is currently logged on to the system, and to retrieve the session key from the authentication server.

As shown in Figure 9, when a file is uploaded from the first client terminal 102 to the SFTS, the file is transferred to a pre-processor 108 which sends an acknowledgement or error message to the sender out box 110

depending on the outcome of the pre-processing. After successful pre-processing, the file is transferred to an in-bound queue 112 of a file transfer processing system (FTPS) on the server side.

When a file is processed by the FTPS, the type of file transfer is determined, and using file transfer parameters stored in a file transfer parameter store 106, the FTPS may perform a file conversion, using one of the plug-in conversion modules 116, before the file is passed on to an out-bound queue 120 by the FTPS. When the file leaves the out-bound queue 120, the file is passed to a post-processor 122, which sends an acknowledgement or an error message to the similar outbox 110, depending on the outcome of post-processing. If post-processing is successful, the file is sent to the recipient outbox 124, where it is retrievable by the FRC of the second client terminal 104. When the second client terminal 104 connects to the SFTS to retrieve the file, an acknowledgement or an error message is sent to the sender out-box, depending on the results of downloading to the second client terminal 104. The first client terminal 102 can then access its sender outbox 110 to confirm correct receipt of the file by the recipient terminal 104, on the basis of the acknowledgements posted to the sender out box, or to retrieve an error message and to re-send the file as appropriate.

Figure 10 illustrates procedures followed by the SFTS when contacted by a client terminal which is to upload and/or download files to/from the SFTS.

First, the SFTS accepts the connection request, step 130, which contains the IP address of the client terminal requesting access. Using this IP address, the SFTS checks in the AS whether the user's IP address is stored in the list of logged-on users. If so, the SFTS retrieves the session key stored in the AS for that user, and confirms with the client terminal that the user has access to the SFTS. If not, the SFTS closes the connection, step 132.

Once the client terminal has received an access confirmation from the SFTS, the client terminal may send requests to the server as illustrated in the remainder of the procedure of Figure 10.

Each user of the file transfer system is a member of at least one of a number of a Closed User Groups (CUGs), whose members are identified in the file transfer parameter database 126. Each Closed User Group has a list of transfer types for its members to use to exchange files amongst each other. A transfer type is created by an administrator of the Closed User Group, by setting up various parameters for the transfer type including its name and a version number which is incremented every time the transfer is updated. This information is stored in the file transfer parameter store 126, and is used by the server to provide the client terminal with a list of transfers available to the user, by using the command/response procedure illustrated in Figure 11.

In order to obtain a directory of the transfer lists available, the FSC of the client terminal sends a "transfers" command in response to which the SFTS sends a series of lines containing the names and version numbers of the transfer lists available to that user, step 134, which is then stored in the client terminal by the FSC. Each CUG has an associated transfer list, and each list name provided in the transfer directory is a representative name for its associated CUG, whereby the user identifies the list required.

When the FSC detects a list which is new, or one which has been updated, the FSC downloads that list from the SFTS using the "GetList" command, as illustrated in Figure 12. In response, the SFTS retrieves the file transfer type list from the file transfer parameter store 126 and transmits it to the client terminal. The list received for the CUG in question is stored by the FSC in the client terminal 4 and later used during file transfer.

Each transfer list includes a header indicating the list name and the version number, and a number of transfer types. For each transfer type, the

list includes a short name, a longer name, an encryption type indicator, an output directory name, an input directory name, an archive directory name, a file mask, a receipt flag, and a delay flag.

The short name included in each transfer type is a unique short name for that transfer type, which is sent during client/server file transfers to identify the transfer type. The longer name of each transfer type is a descriptive name which is displayed to the user to allow the user to identify and select the transfer type.

The encryption type indicator in each transfer type has three possible settings, namely "none", "normal" or "delayed". If the indicator is "none", no encryption is used during upload/download of files. If the indicator is "normal" the files are encrypted/decrypted during upload/download from the SFTS by the security layer of the client terminal and by the SFTS itself. If the indicator is "delayed" the files are encrypted/decrypted during upload/download from the server, as is the case for "normal", and the file is also encrypted a second time prior to transmission with an "embargo" key, to be described later.

The output directory name is a suggested directory where files for this particular type of transfer are to be retrieved from for sending. When selecting files for upload the FSC takes the user to this directory, although the user is still able to select files from a different directory.

The input directory name is a suggested directory where files for this particular type of transfer are to be stored on receipt. When downloading a file, the FRC places the file in this directory unless otherwise specified by the user.

The archive directory is a suggested directory where files of this type of transfer will be moved to in the sending terminal system after a successful upload. Again, the user can choose a different archive directory if desired.

The file mask for each transfer type defines a file selection mask which guides the selection of files for transfer using this transfer type. If a transfer requires multiple file selection masks, multiple file mask entries are specified.

The receipt flag is set either at "Y" or "N". If "Y" an automatic acknowledgement is required from the server when the file is pre-processed, delivered for download and downloaded by the recipient, respectively. If "N" no acknowledgement is required.

The delay flag for a transfer type may be "Y", or "N". If "Y" files of this type will be delayed by storing the file in the recipient outbox 124, and made available for delivery only after a date which is specified by the user. If "N", the files are made available in recipient outbox 124 without delay.

Once the terminal is sent any new transfer list, the user is able to request a file to be uploaded to the SFTS, using the command/response procedure illustrated in Figure 13. The FSC initiates the transfer by sending the "sendfile" command with the name of the file to be uploaded (with any directory pre-fixes removed) and the identity of the intended recipient(s). The SFTS will generate a unique ID for this transfer which is then sent to the client terminal. The transfer ID is used by the server to identify a file throughout the transfer process and provides a means of preventing errors which would otherwise occur with duplicate file names.

Once the transfer ID has been assigned, the FSC sends the SFTS headers specifying the chosen transfer type, the original size of the file (in bytes), the total number of bytes that will be sent (including the overhead from the encryption process), and an optional date which represents when a file may be released (if using embargoed encryption) or when a file should be made available for delivery (in the case of deferred transfers).

When the headers have been sent, the encrypted file data is sent to the server as a series of blocks having the configuration illustrated in Figure 14.

Each data block includes five parts, including an initialisation vector 150 for the decryption process, added during encryption and prior to transmission of the block. The block also includes a block number, 152, which increments with each block of data sent, and a data count 154, which is a count of the number of data bytes included in the data block, excluding the initialisation vector 150, block number, data count, checksum and any padding added during the encryption process. The next part of the data block is the part holding the encrypted data 156, which is padded to a multiple of 8 bytes by the encryption function if the data block is not otherwise a multiple of 8 bytes. The final part of the data block is an encryption checksum 158, which is added by the encryption function and checked and removed by the decryption function to ensure that the data block has been received correctly after transmission.

When an uploaded file is received by the SFTS, the file is generally processed by the pre-processor 108, the FTPS and the post-processor 122, and is sent to the outbox 124 of the intended recipient of the file.

Each recipient outbox keeps an updated directory of files to be downloaded to the recipient, which directory can be downloaded by a receiving client terminal FRC, step 140, by using the command/response procedure illustrated in Figure 15. If the transfer type indicates a deferred transfer, the file is stored invisibly in the recipient outbox and included in the directory only after the time and date specified in the transfer request.

To obtain a list of files waiting on the server for the user to download (if any), the FRC sends a "Directory" command, in response to which the SFTS sends a directory listing which contains, for each directory entry, the transfer ID assigned to the file when it was uploaded by the sender, the file transfer type, the original name of the file, the original size of the file in bytes, the total number of bytes that will be sent if the file is downloaded, the

user ID of the file sender, the date upon which the file was delivered to the user's outbox on the server, an encryption flag ("Y" if the file users embargoed encryption, "N" for other types of transfers), a date/time upon which the embargo key will be released for distribution if the file is embargoed, and a unique identifier for the embargo key used to encrypt the embargoed file, if the file is embargoed.

Once the FRC has received a directory of the files waiting to be retrieved the FRC may download one of the files, step 142, using the command/response sequence illustrated in Figure 16. To initiate the download of a file, the FRC sends a "Getfile" command to the server with the transfer ID as indicated in the directory listing of the file to be retrieved. The FRC then sends the "Block" line to indicate which data blocks are to be downloaded. The "Block" line can indicate a single block number (eg "0"), a list of blocks (eg "0, 1, 2, 5") or a range of blocks (eg "0-9"). To download a file in its entirety, the FRC sends a block line with a block number of zeros. The SFTS then encrypts the file using the session key held for the receiving client terminal, and sends the selected data blocks to the FRC.

At the receiving terminal end, the security layer SL uses the session key to decrypt the file. Should the downloaded file fail to decrypt correctly, the file is retrieved from the SFTS again in its entirety.

For added security on the server side, it is possible to re-encrypt a file with a locally-generated encryption key after decryption using the session key of the sending terminal, and to decrypt the file using the locally-generated encryption key immediately prior to processing by the FTPS. It is also then possible to re-encrypt the file with a further locally-generated encryption key after processing by the FTPS, and to decrypt the file using the further locally-generated encryption key immediately prior to re-encryption of the file using

the session key of the receiving terminal.

If a file transfer is of an embargoed type, as well as being encrypted with the session key of the receiving terminal, it is also encrypted by the SFTS using an "embargo" key prior to delivery and assigned an embargo key identifier. This means that once downloaded, the file still cannot be read as it remains encrypted with an encryption key derived from the embargo key after decryption using the session key. The file encrypted using the embargo key is stored along with the embargo key identifier by the FRC in the client terminal until such time as the embargo key is released and the file can be decrypted.

Embargo keys are generated either automatically or manually. If automatically generated, the SFTS will assign a randomly generated key when the uploaded embargo file is processed. If manually generated, a system administrator will have entered embargo keys for one or more specific transfers in advance.

The embargo key consists of a series of words or a phrase, with up to 40 characters. Before an embargo key is used, it is hashed using the H0 hashing function illustrated in Fig. 4, using the embargo key twice as first and second inputs to the function, to produce the actual encryption key for use in the encryption/decryption process described above.

The embargo key is delivered by E-mail or file transfer at the time and date specified when the embargoed file is uploaded to the SFTS. When the embargo key is sent, the E-mail message or the file transfer containing the embargo key includes the identifier for the embargo key, the embargo key itself, the encryption key generated from the embargo key using the H0 function and one or more file transfer ID's for which the embargo key may be used to decrypt the files.

The embargo key may be made available to a user by other means, for

example by normal postal services, or by posting the embargo key onto a WWW site, which can be accessed by users after the date and time specified for release of the embargo keys.

Figure 17 illustrates a further embodiment of the present invention, in the form of an E-mail server, 160, which is able to accept messages from an E-mail client application 161 via the Internet, to store the message in a delayed E-mail store 162 until a prescribed date and time, and then to deliver the message to the mailbox 164 of the recipient at the prescribed date and time. After the prescribed date and time, the recipient mail client 166 is able to retrieve the message for viewing by the user.

The delayed E-mail message is essentially similar to a conventionally-known E-mail message, and contains extra fields in the message header. These extra fields include a "delayed" field, which marks the message as a "delayed" E-mail, and specifies the date and time when the E-mail should be delivered to the mailbox of the recipient. The date and time are indicated using the day of the month, the month of the year, the year, the hour of the day and the minute past the hour of the intended delivery time. The extra fields also include a "confirm delivery" field which indicates whether the sender requires an acknowledgement when the delayed message is sent to the recipient. If no acknowledgement is required, the "confirm delivery" field need not be supplied, or is set to negative.

The delayed E-mail server 160 may thus be used to transmit a message from the SFTS containing an embargo key, which indicates the date and time at which the embargo key should be released to a file recipient. The mail server 160 then delivers the embargo key at the required date and time without further reference to the SFTS. If an acknowledgement is required by the SFTS, the server 160 sends an acknowledgement to the SFTS confirming delivery, or an error message if the message could not be correctly

transmitted.

It will be appreciated that various modifications and variations are possible in relation to the above-described embodiments without departing from the spirit or scope of the present invention.

CLAIMS:

1. A method of authenticating users for access via remote terminals to a plurality of application servers, said method comprising the steps of:

storing authentication details of authorised users;

performing remote authentication of users with reference to said stored authentication details;

storing data identifying users which are currently authenticated; and

allowing said plurality of application servers to access said data identifying currently authenticated users to check an authentication status of a user.

2. A method according to claim 1, wherein said authentication step comprises issuing a challenge to a user terminal, receiving a response to said challenge, and verifying said response.

3. A method according to claim 2, wherein said authentication step further comprises generating a random string for use as said challenge and computing an expected response for use during verification.

4. A method according to claim 3, wherein said expected response is computed using an authenticator derived from a password and stored with said authentication details.

5. A method according to claim 4, wherein said authenticator is a hash produced by a one-way hashing function acting on a user password.

6. A method according to claim 4 or 5, further comprising the step of

allowing a user to change the authenticator stored with said identification details, by receiving a new password as a hash produced by a one-way hashing function from said user terminal.

7. A method according to any preceding claim, further comprising producing an encryption key during said remote authentication step.

8. A method according to claim 7, wherein said encryption key is stored as a shared secret key on said user terminal and in said data identifying users which are currently authenticated.

9. A method according to any preceding claim, further comprising the step of periodically performing re-authentication of a user in order to update said data identifying users which are currently authenticated.

10. A method according to claim 9, wherein said re-authentication step comprises issuing a challenge to a user terminal, receiving a response to said challenge, and verifying said response.

11. A method according to claim 9 or 10, wherein said re-authentication step is performed in response to a time-out associated with said data identifying currently authenticated users.

12. A method according to claim 9 or 10, wherein said re-authentication step is performed in response to access by one of said application servers to said data identifying currently authenticated users.

13. A method according to claim 9 or 10, wherein said re-authentication

step is performed in response to a request by a user terminal.

14. A method according to any preceding claim, wherein said remote authentication is performed over the Internet.

15. A method according to claim 14, wherein said users are identified by means of the IP address of their user terminals by said application servers.

16. A method according to claim 1 or 2, wherein said authentication step comprises issuing an identification token to a user terminal.

17. A method according to claim 16, wherein said authentication step comprises receiving said identification token from said user terminal with an authenticator of a user at said user terminal.

18. A method according to claim 17, wherein said authenticator comprises a hash produced by a one-way hashing function acting on a user password.

19. A method according to claim 17 or 18, wherein said authentication step comprises issuing a new identification to said user terminal if said authenticator is invalid.

20. A method according to claim 19, wherein said new identification token comprises data indicating the number of times an invalid authenticator has been received from said user terminal.

21. A method according to claim 20, wherein said method comprises refusing access by said user terminal to said application servers if said

identification token indicates that a predetermined number of invalid authenticators have been received from said user terminal.

22. A method according to any preceding claim, wherein said data identifying currently authenticated users is stored on a storage means which said application servers are each able to access.

23. A method according to any preceding claim, wherein said authentication details include data identifying the rights of access of individual users to one or more of said application servers.

24. A method according to claim 23, wherein some users have access rights to only some of said application servers.

25. A method according to any preceding claim, further comprising storing data identifying the periods for which users have held a currently-authenticated status.

26. A method according to any preceding claim, further comprising analysing said data identifying users which are currently authenticated to ensure only a predetermined concurrency of authenticated users is present therein.

27. Apparatus for performing the steps of any preceding claim.

28. Apparatus according to claim 27, wherein said authentication step is performed by an authentication server.

29. A method of transferring a file between a user at a first client terminal and a user at a second client terminal over the Internet, said method comprising the steps of:

establishing a first session key by communicating with said first client terminal over the Internet;

receiving the file encrypted with the first session key from the first client terminal over the Internet;

decrypting the file using the first session key;

establishing a second session key by communicating with said second client terminal over the Internet;

encrypting the file using the second session key; and

transmitting the file encrypted with the second session key to the second client terminal.

30. A method according to claim 29, comprising storing said file after receipt from said second client terminal until requested by said second client terminal.

31. A method according to claim 30, comprising storing said file after transmission to said second client terminal until a command is received from said second terminal to delete said file.

32. A method according to claim 30 or 31, comprising transmitting a list of stored files to said second client terminal, and transmitting one of said stored files in response to a selection from said list by said second client terminal.

33. A method according to claim 30, 31 or 32, comprising encrypting said

file with a third encryption key during said storage, and decrypting said file with said third encryption key before transmission.

34. A method according to any of claims 29 to 33, comprising transmitting an acknowledgement to said first client terminal after successful transmission of said file to said second client terminal.

35. A method according to any of claims 29 to 34, wherein said first and second session keys are generated by issuing a different random string to said first and second client terminals, respectively.

36. A method according to any of claims 29 to 35, comprising storing said file for a predetermined period before said second client terminal is able to access said file.

37. A method according to any of claims 29 to 35, comprising encrypting said file with a fourth encryption key before transmitting said file to said second client terminal, and subsequently releasing said fourth encryption to said second client terminal to allow decryption of said file only after a predetermined period.

38. A method according to claim 36 or 37, wherein said predetermined period is specified in a message received from said first client terminal.

39. A method according to any of claims 29 to 38, further comprising storing file transfer parameters defining a plurality of different types of file transfer and transmitting a list of different transfer types to said first client terminal.

40. A method according to claim 39, further comprising receiving data identifying one of said file transfer types from said first client terminal for processing said file when received from said first client terminal.

41. Apparatus for performing the steps of any of claims 29 to 40.

42. A method of transferring a file from a first client terminal to a second client terminal, said method comprising the steps of:

holding file transfer parameters for a plurality of different file transfer types;

transmitting data relating to at least one of said different file transfer types to said first and/or second client terminal; and

conducting a file transfer between said first and second client terminals in accordance with file transfer parameters stored for a selected file transfer type.

43. A method according to claim 42, comprising:

receiving said file from said first client terminal;

receiving data identifying a selected file transfer type from said first client terminal; and

transmitting said file to said second client terminal in accordance with the file transfer parameters stored for said selected transfer type.

44. A method according to claim 42 or 43, wherein said holding step comprises holding a list of transfer types associated with each of a plurality of user groups, and transmitting a list to said first client terminal when a user at said first client terminal is a member of the associated user group.

45. A method according to claim 42, 43 or 44, wherein said file transfer parameters include a file encryption parameter, and wherein said file transfer step comprises encrypting said file during said transfer in accordance with a file encryption parameter stored for the selected file transfer type.

46. A method according to claim 45, wherein said file encryption parameter indicates an embargo period for said encrypted file, and said method comprises transmitting an encryption key to said second client terminal to allow said file to be decrypted after said embargo period has expired.

47. A method according to any of claims 42 to 46, wherein said file transfer parameters include a suggested storage directory for a file.

48. A method according to any of claims 42 to 47, wherein said file transfer parameters include a file acknowledgement parameter, and said file transfer step comprises transmitting an acknowledgement to said first client terminal in accordance with a file acknowledgement parameter stored for the selected file transfer type.

49. A method according to any of claims 42 to 48, wherein said file transfer parameters include a transmission delay parameter, and said file transfer step comprises transmitting said file to said second client terminal only after expiry of a delay period in accordance with a transmission delay parameter stored for said selected file transfer type.

50. Apparatus for performing the steps of any of claims 42 to 48.

51. An application server for transferring data from a first client terminal

to a second client terminal, said application server comprising means for receiving said data from said first client terminal, means for receiving a delay period indicator for said data from said first client terminal, and means for transmitting said data to said second client terminal such that said data can only be read by a user at said second client terminal after expiry of said delay period.

52. An application server according to claim 51, wherein said application server comprises means for encrypting said data with an encryption key prior to transmission to said second client terminal, and means for forwarding said encryption key such that said second client terminal is able to access said encryption key only after expiry of said delay period.

53. An application server according to claim 52, wherein said application server comprises means for transmitting said encryption key to said second client terminal after expiry of said delay period.

54. An application server according to claim 51, comprising means for storing said data for the duration of said delay period prior to transmission of said data to said second client terminal.

55. An E-mail server according to claim 54, wherein said data comprises an E-mail message.

Fig.1.

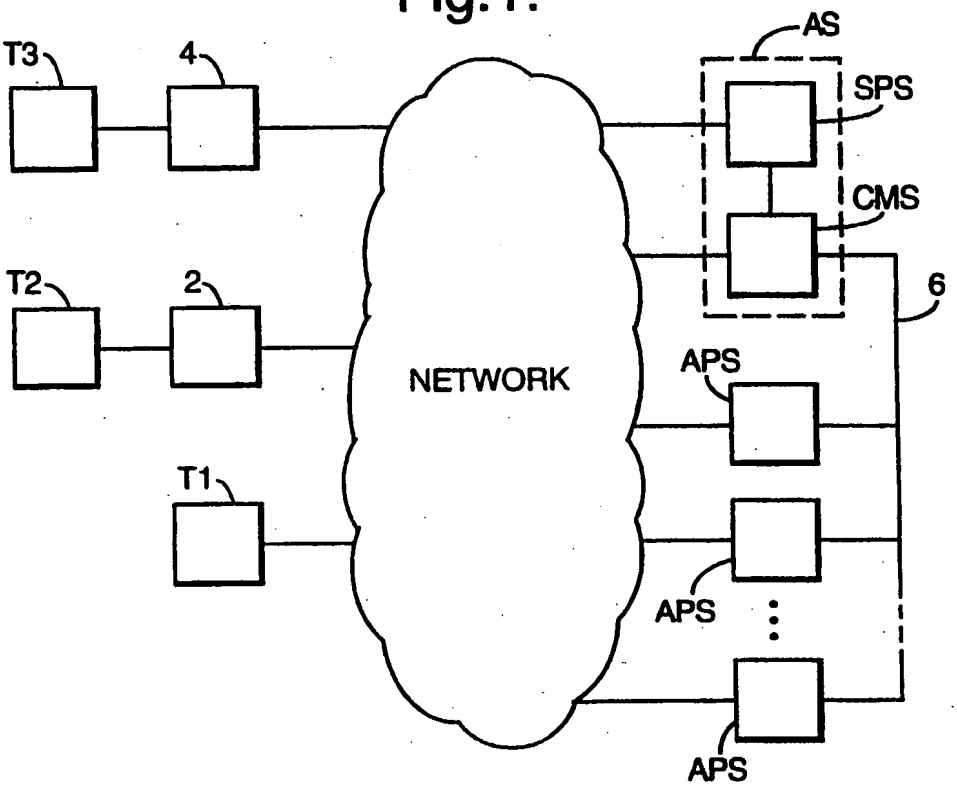
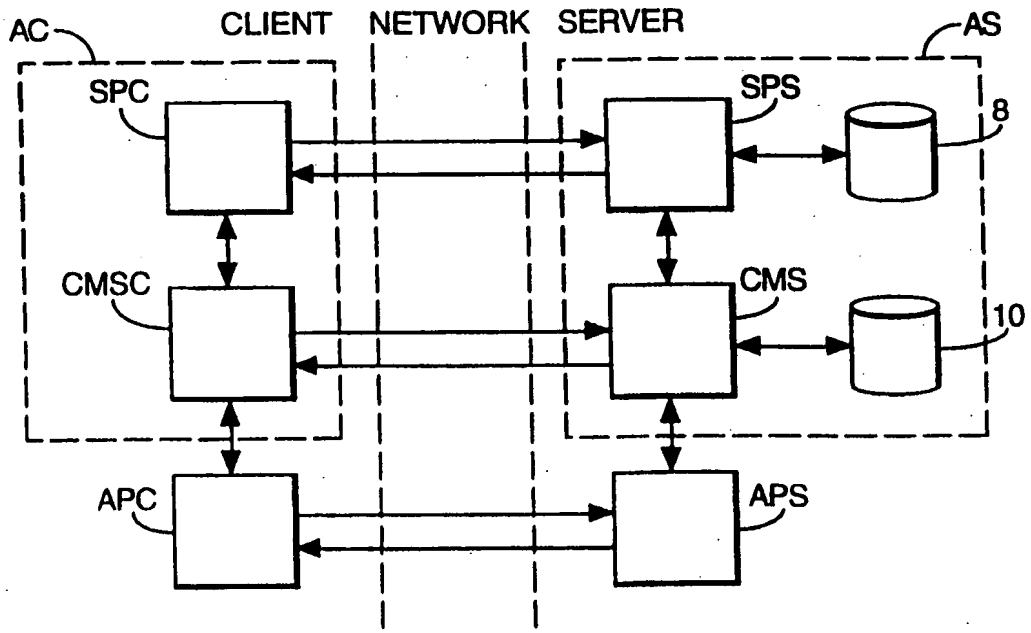

T3
4
AS
SPS
CMS
6
T2
2
NETWORK
APS
T1
APS
APS

Fig.2.


AC
CLIENT
NETWORK
SERVER
AS
SPC
SPS
8
CMSC
CMS
10
APC
APS

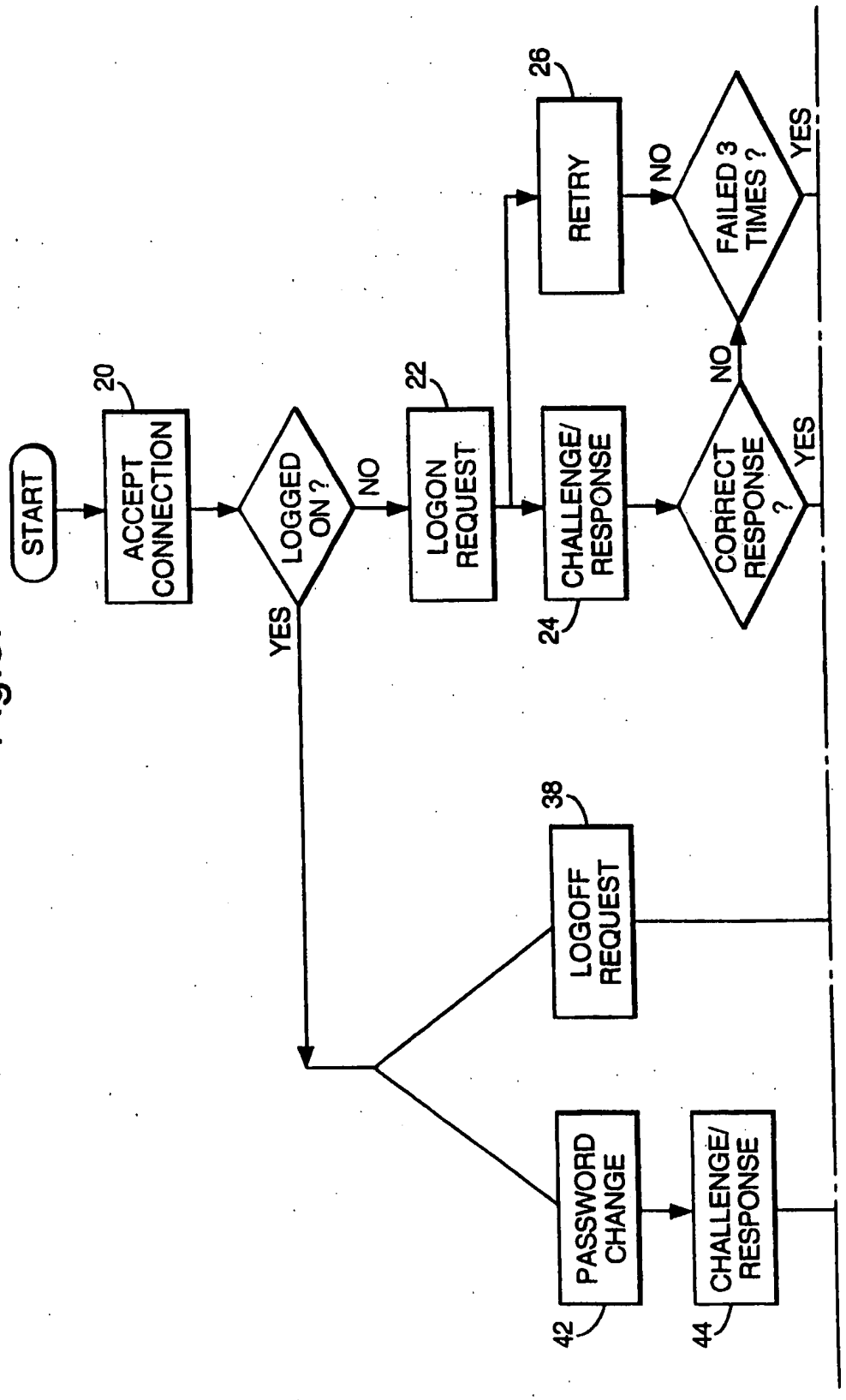

START
ACCEPT CONNECTION
20
LOGGED ON ?
YES
NO
LOGON REQUEST
22
CHALLENGE/ RESPONSE
24
CORRECT RESPONSE ?
YES
NO
RETRY
26
FAILED 3 TIMES ?
YES
NO
LOGOFF REQUEST
38
PASSWORD CHANGE
42
CHALLENGE/ RESPONSE
44

Fig.3.

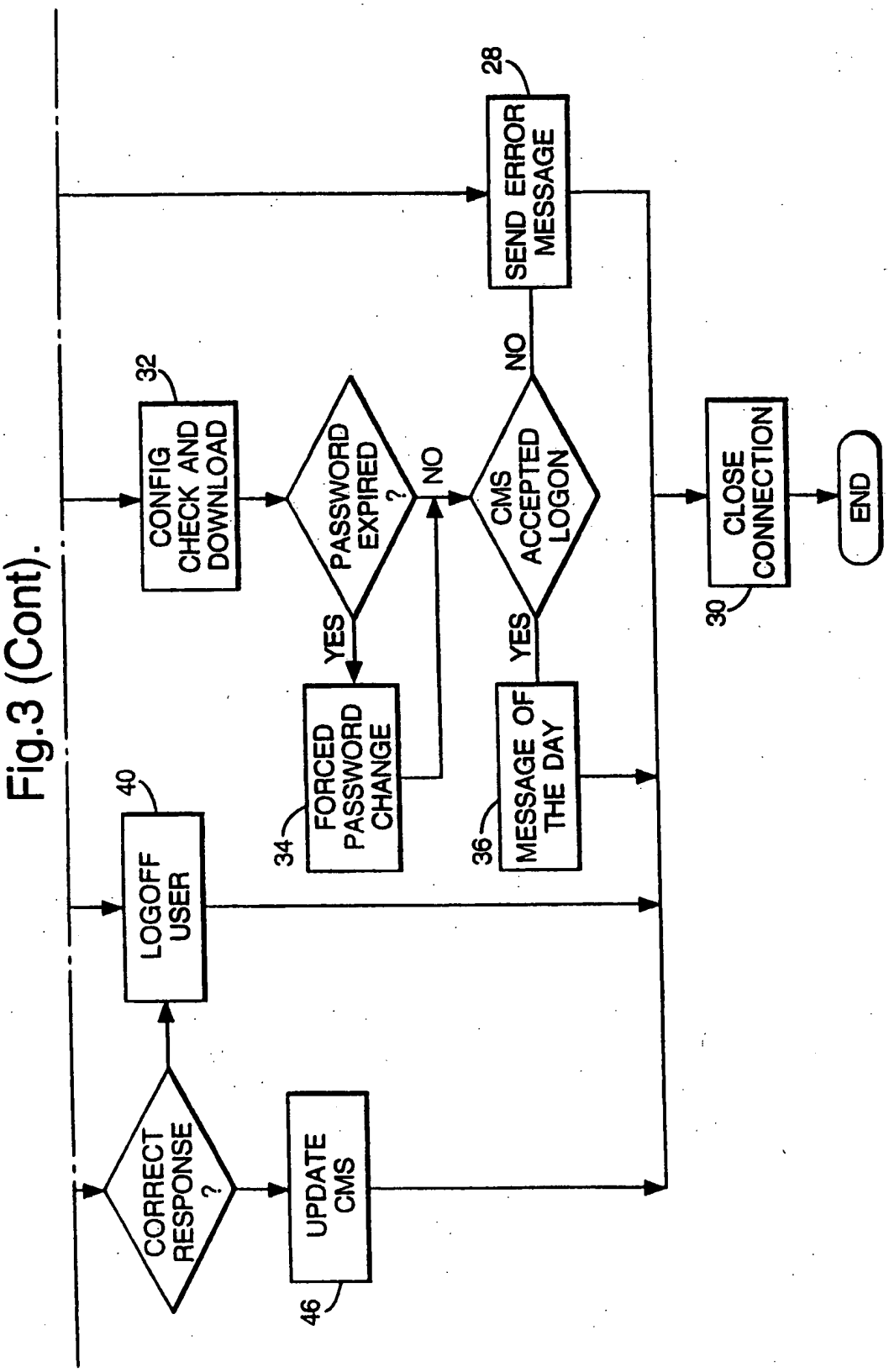


Fig.3 (Cont).
CORRECT RESPONSE ?
UPDATE CMS
46
LOGOFF USER
40
FORCED PASSWORD CHANGE
34
MESSAGE OF THE DAY
36
CONFIG CHECK AND DOWNLOAD
32
PASSWORD EXPIRED ?
YES
NO
CMS ACCEPTED LOGON
YES
NO
SEND ERROR MESSAGE
28
CLOSE CONNECTION
30
END

Fig.4.

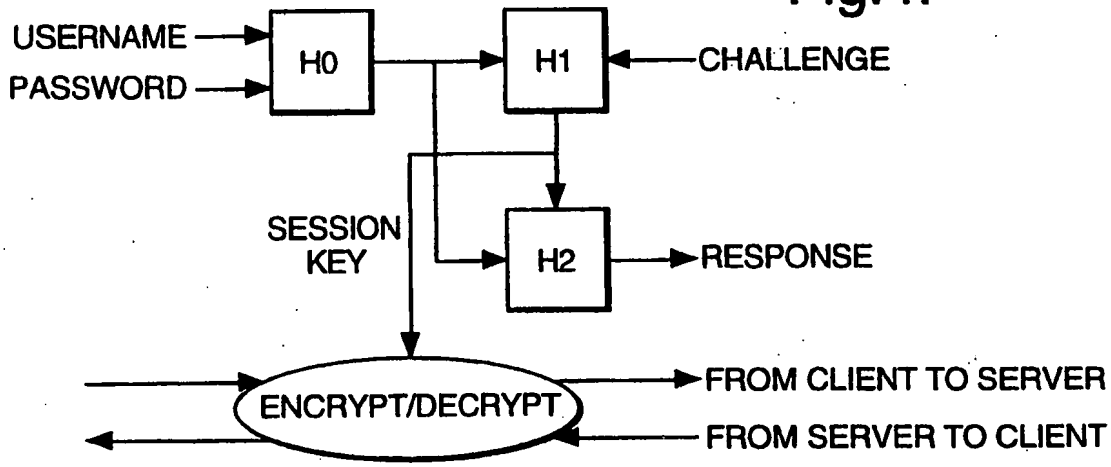

USERNAME
PASSWORD
H0
H1
CHALLENGE
SESSION KEY
H2
RESPONSE
ENCRYPT/DECRYPT
FROM CLIENT TO SERVER
FROM SERVER TO CLIENT

Fig.5.

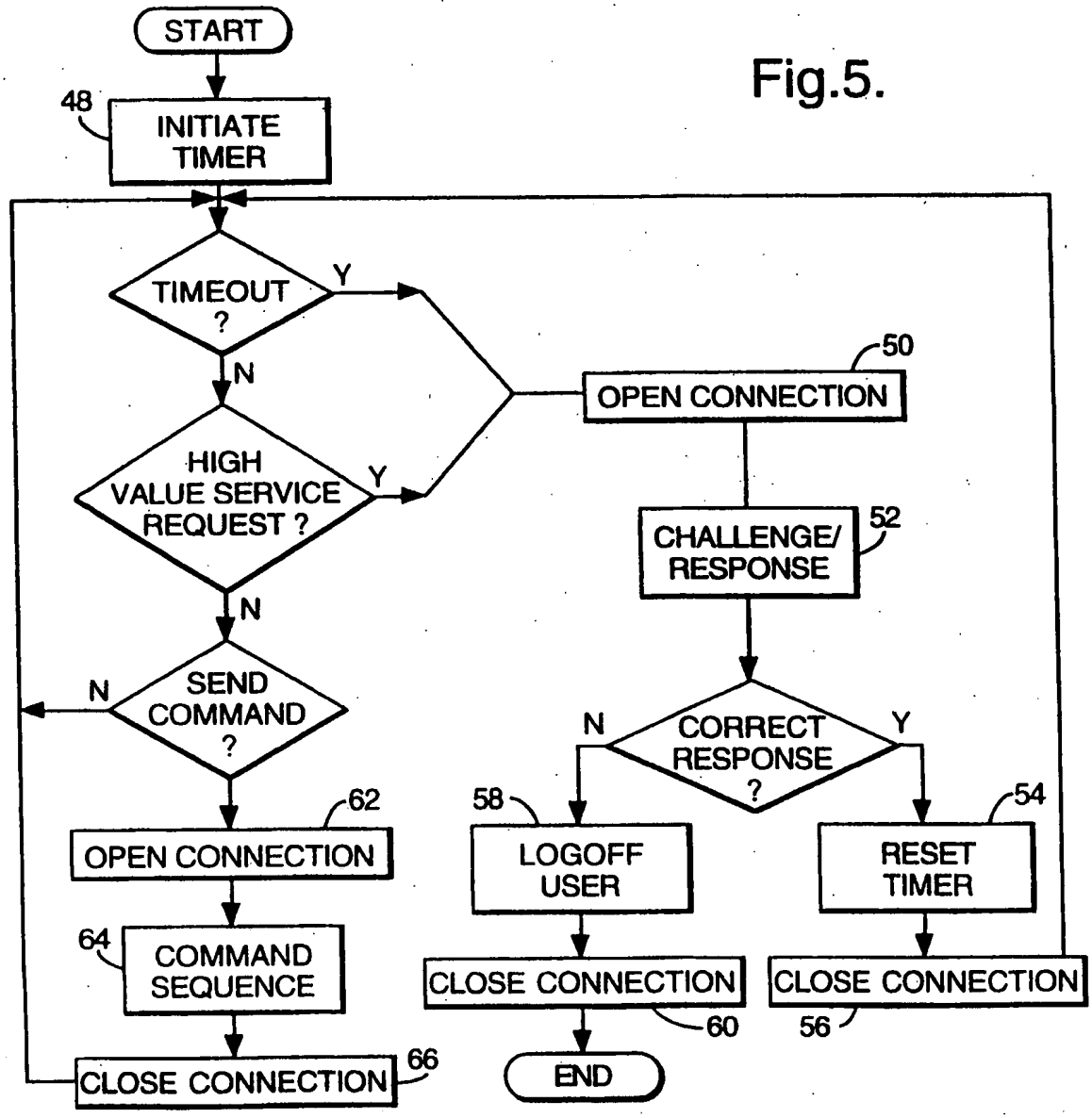

START
48
INITIATE TIMER
TIMEOUT ?
Y
N
HIGH VALUE SERVICE REQUEST ?
Y
N
SEND COMMAND ?
N
50
OPEN CONNECTION
52
CHALLENGE/ RESPONSE
N
CORRECT RESPONSE ?
Y
58
LOGOFF USER
54
RESET TIMER
62
OPEN CONNECTION
64
COMMAND SEQUENCE
CLOSE CONNECTION
66
CLOSE CONNECTION
60
CLOSE CONNECTION
56
END

Fig.8.

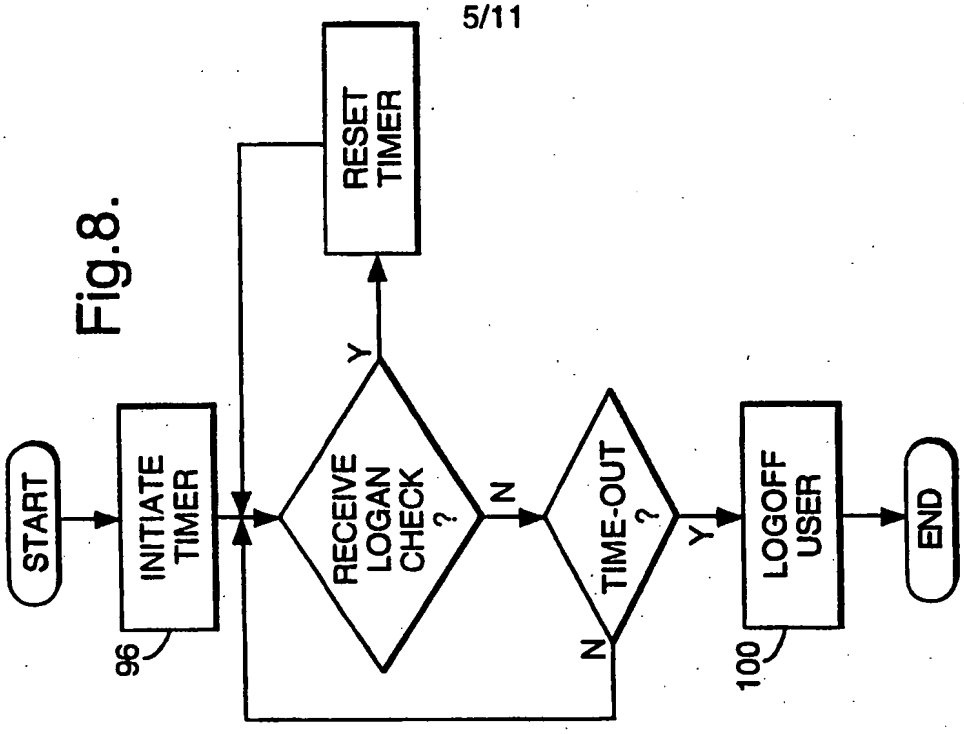

START
INITIATE TIMER
96
RECEIVE LOGAN CHECK ?
Y
RESET TIMER
N
TIME-OUT ?
N
Y
LOGOFF USER
100
END

Fig.6.

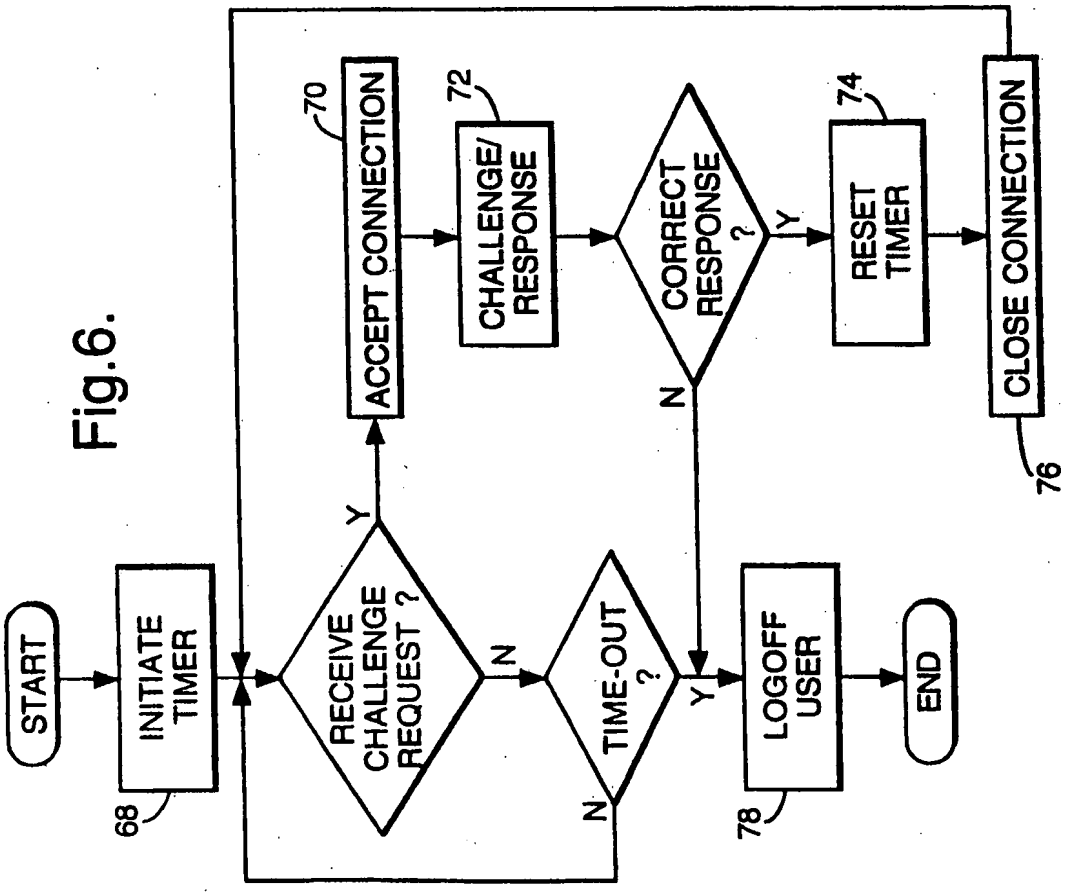

START
INITIATE TIMER
68
RECEIVE CHALLENGE REQUEST ?
Y
ACCEPT CONNECTION
70
CHALLENGE/ RESPONSE
72
CORRECT RESPONSE ?
Y
N
RESET TIMER
74
CLOSE CONNECTION
76
N
TIME-OUT ?
Y
LOGOFF USER
78
END

Fig.7.

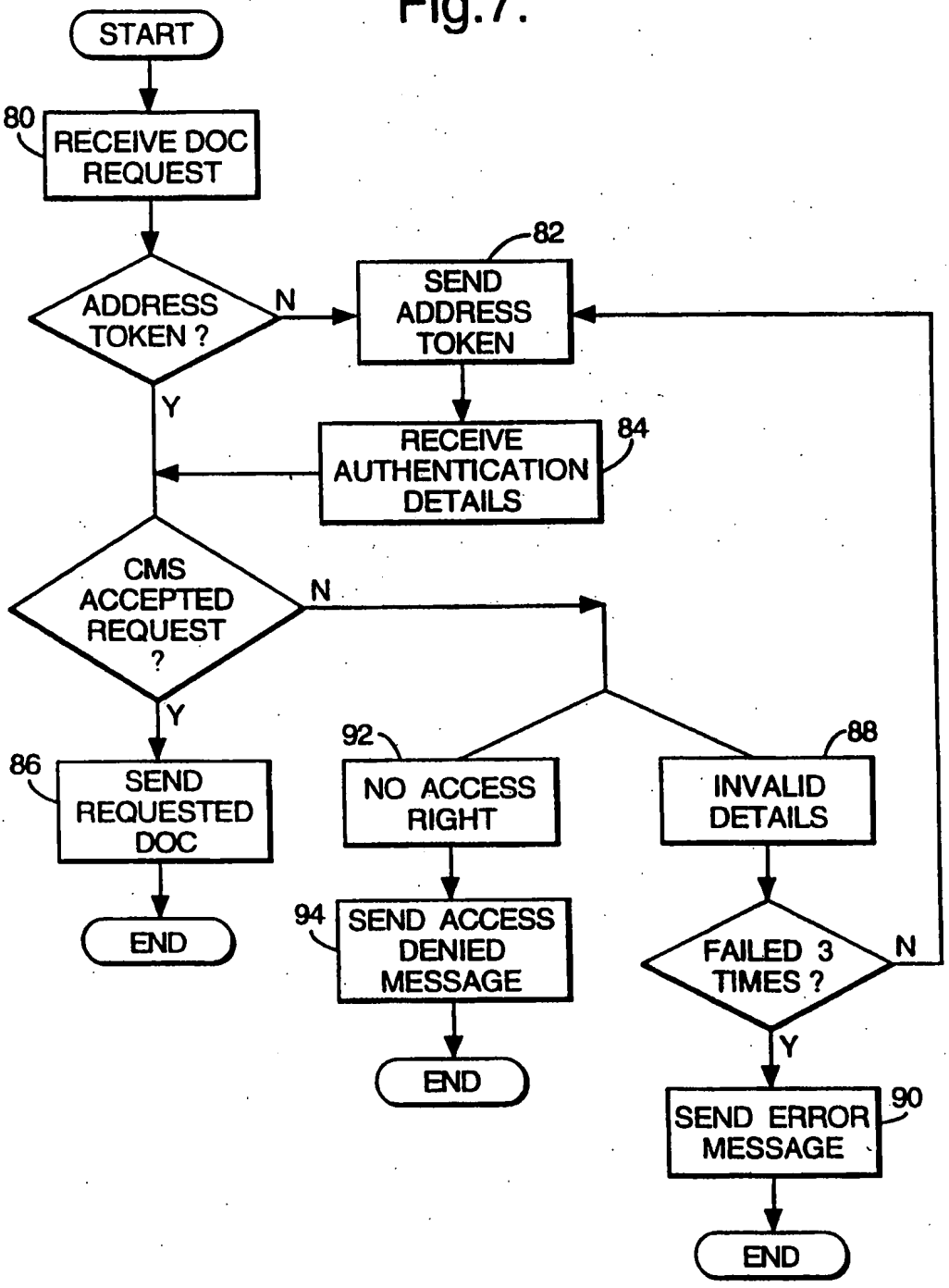

START
80
RECEIVE DOC REQUEST
ADDRESS TOKEN ?
N
82
SEND ADDRESS TOKEN
Y
RECEIVE AUTHENTICATION DETAILS
84
CMS ACCEPTED REQUEST ?
N
Y
86
SEND REQUESTED DOC
END
92
NO ACCESS RIGHT
94
SEND ACCESS DENIED MESSAGE
END
88
INVALID DETAILS
FAILED 3 TIMES ?
N
Y
SEND ERROR MESSAGE
90
END

Fig.9.

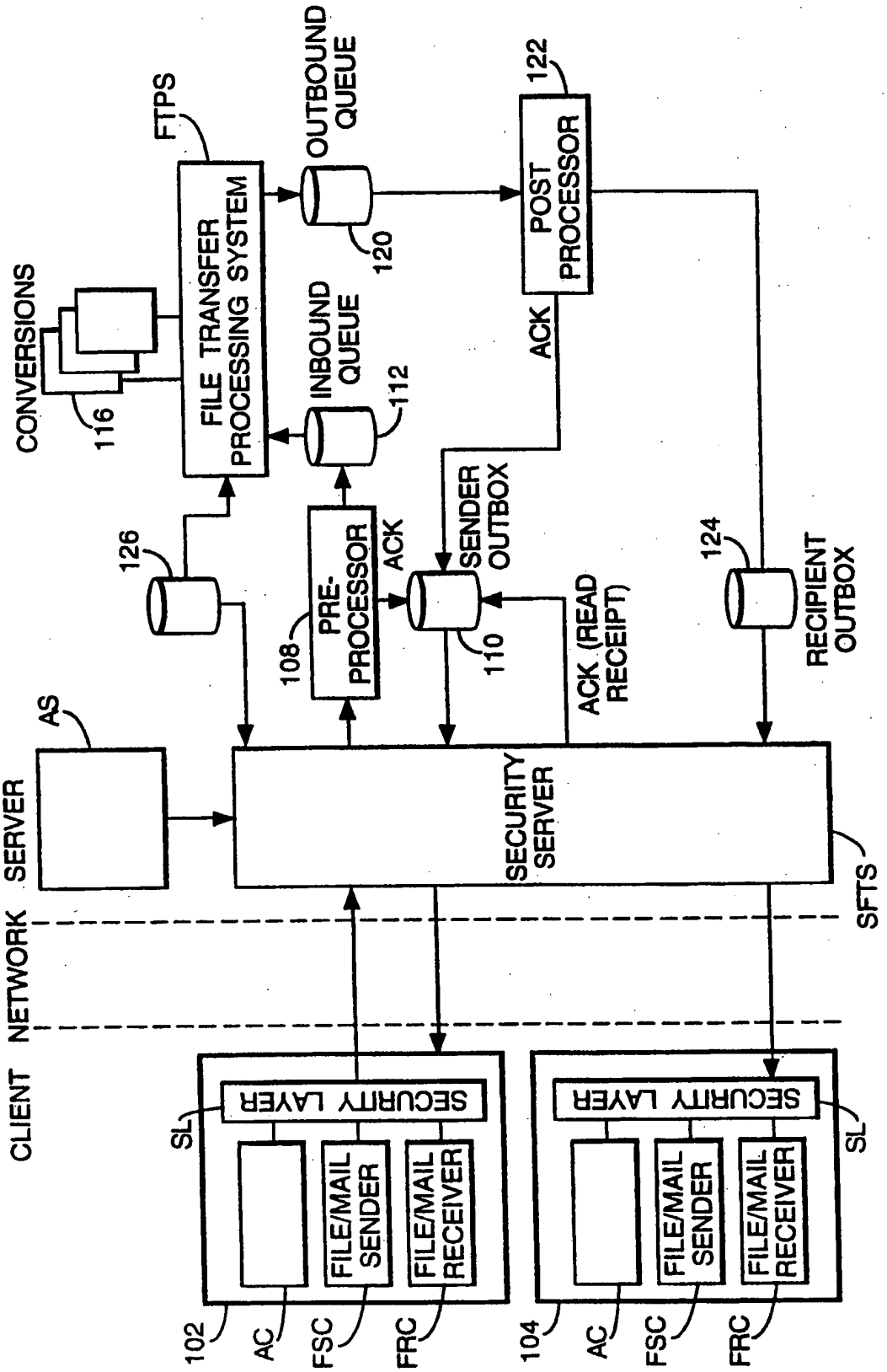

CLIENT NETWORK
SERVER
AS
SECURITY SERVER
SFTS
SECURITY LAYER
SL
FILE/MAIL SENDER
FILE/MAIL RECEIVER
102
AC
FSC
FRC
104
FTPS
FILE TRANSFER PROCESSING SYSTEM
CONVERSIONS
116
OUTBOUND QUEUE
120
INBOUND QUEUE
112
POST PROCESSOR
122
ACK
126
PRE-PROCESSOR
108
ACK
SENDER OUTBOX
110
ACK (READ RECEIPT)
124
RECIPIENT OUTBOX

Fig.10.

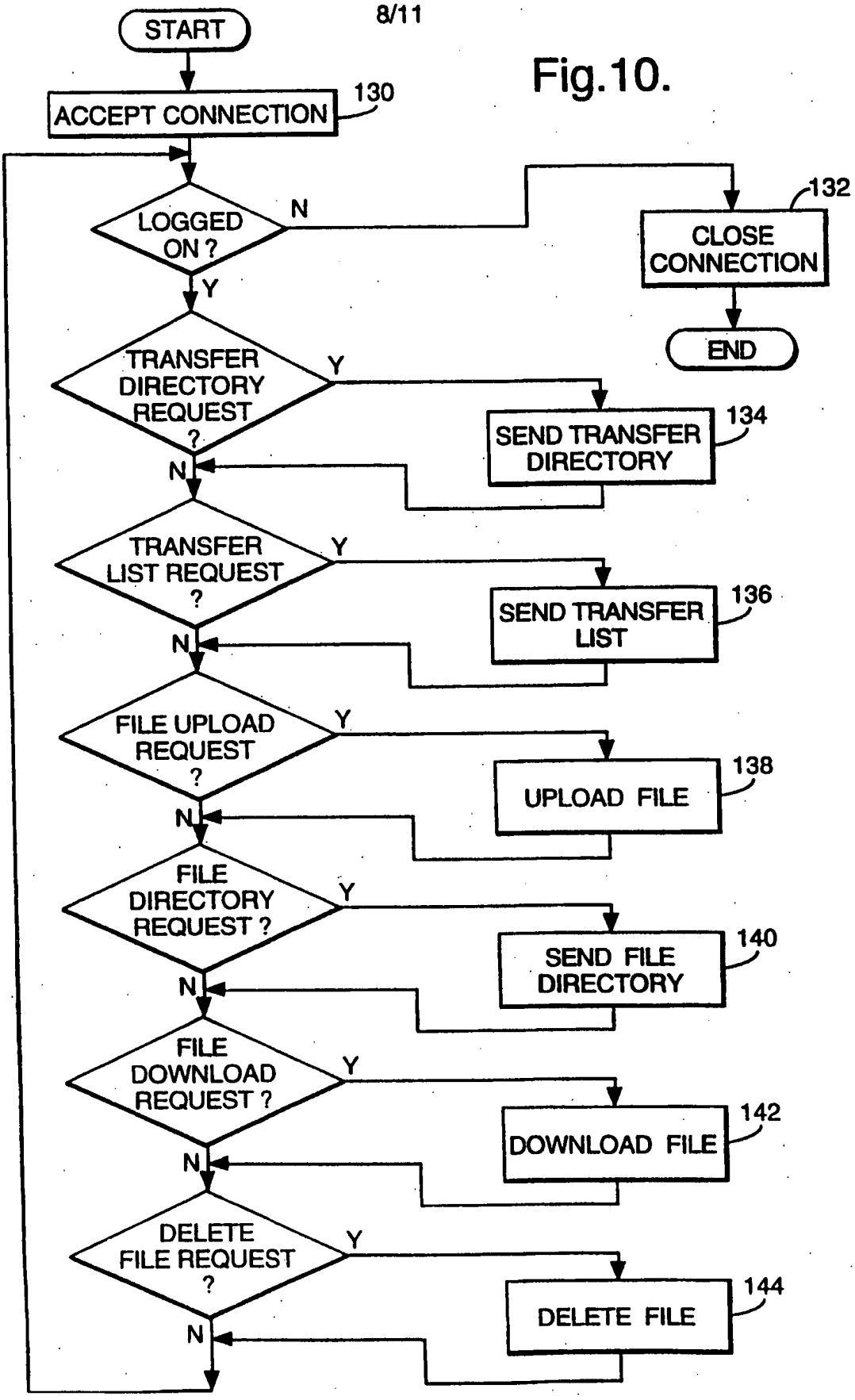

START
ACCEPT CONNECTION
130
LOGGED ON ?
N
Y
132
CLOSE CONNECTION
END
TRANSFER DIRECTORY REQUEST ?
Y
N
SEND TRANSFER DIRECTORY
134
TRANSFER LIST REQUEST ?
Y
N
SEND TRANSFER LIST
136
FILE UPLOAD REQUEST ?
Y
N
UPLOAD FILE
138
FILE DIRECTORY REQUEST ?
Y
N
SEND FILE DIRECTORY
140
FILE DOWNLOAD REQUEST ?
Y
N
DOWNLOAD FILE
142
DELETE FILE REQUEST ?
Y
N
DELETE FILE
144

Fig.11.

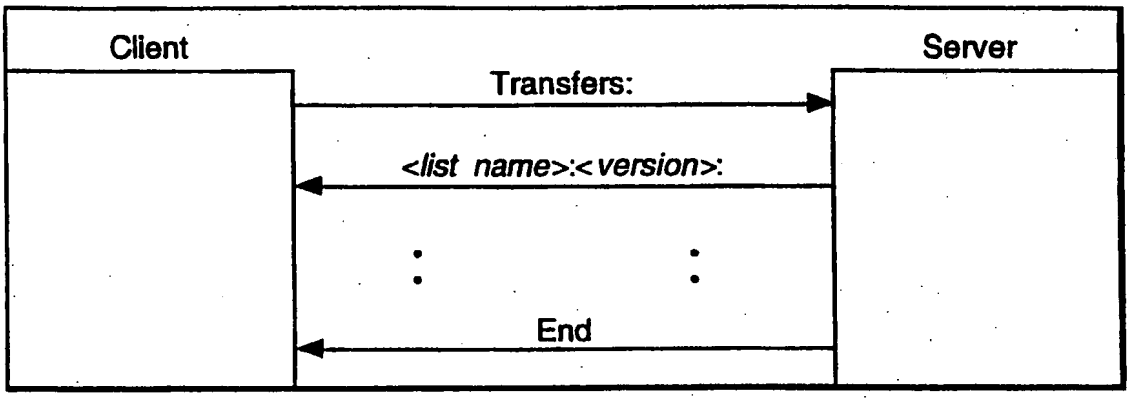

Client
Server
Transfers:
<list name>:<version>:
End

Fig.12.

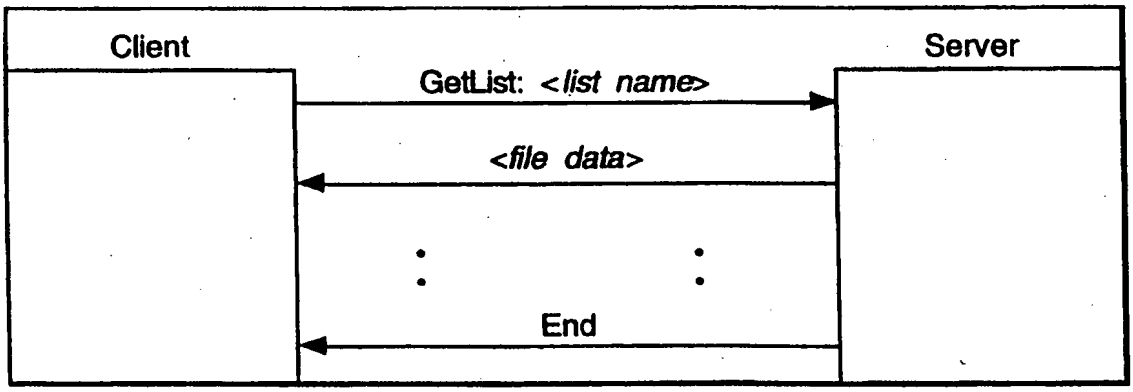

Client
Server
GetList: <list name>
<file data>
End

Fig.13.

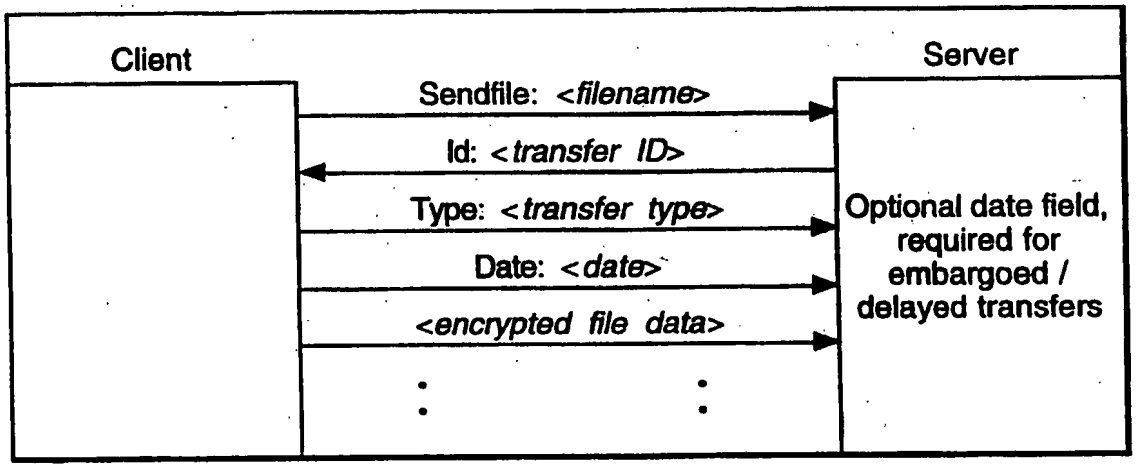

Client
Server
Sendfile: <filename>
Id: <transfer ID>
Type: <transfer type>
Date: <date>
<encrypted file data>
Optional date field, required for embargoed / delayed transfers

Fig.14.

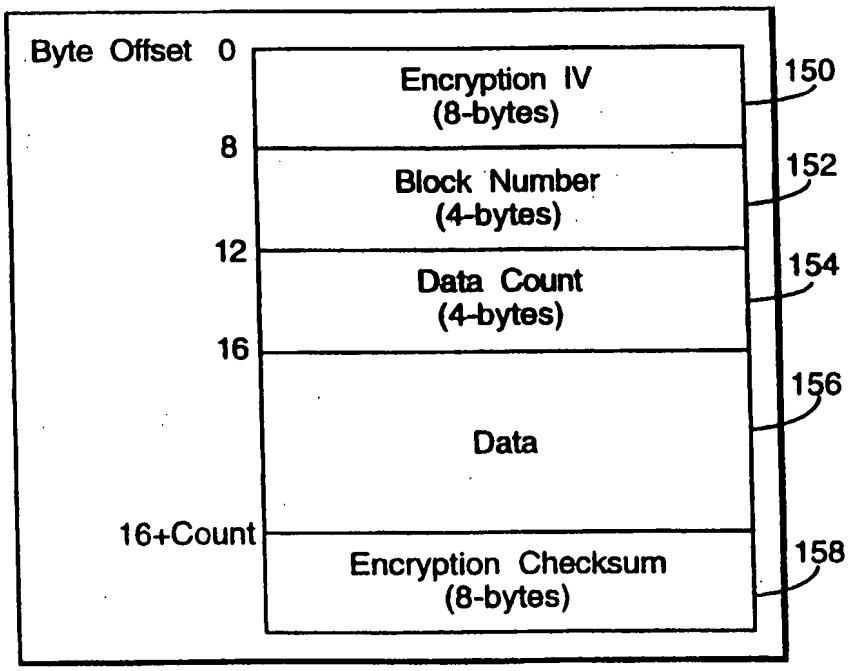

Byte Offset
0
8
12
16
16+Count
Encryption IV (8-bytes)
Block Number (4-bytes)
Data Count (4-bytes)
Data
Encryption Checksum (8-bytes)
150
152
154
156
158

Fig.15.

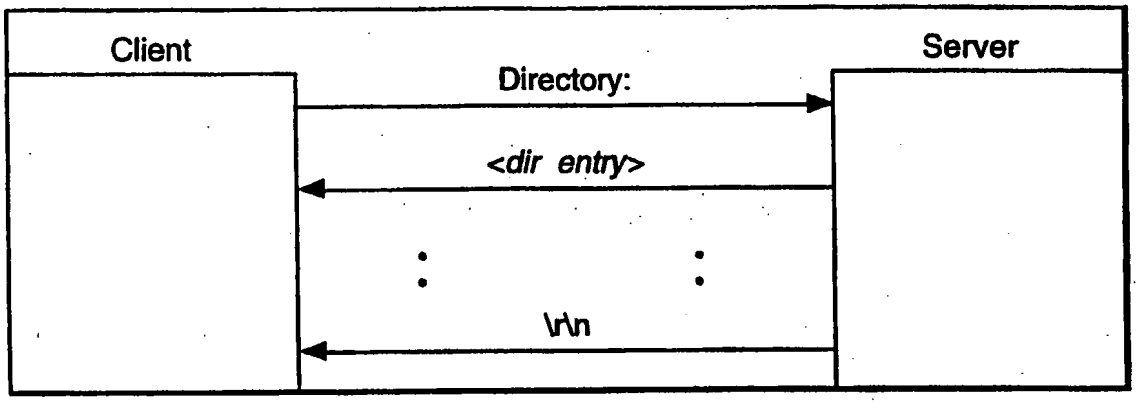


Fig.16.

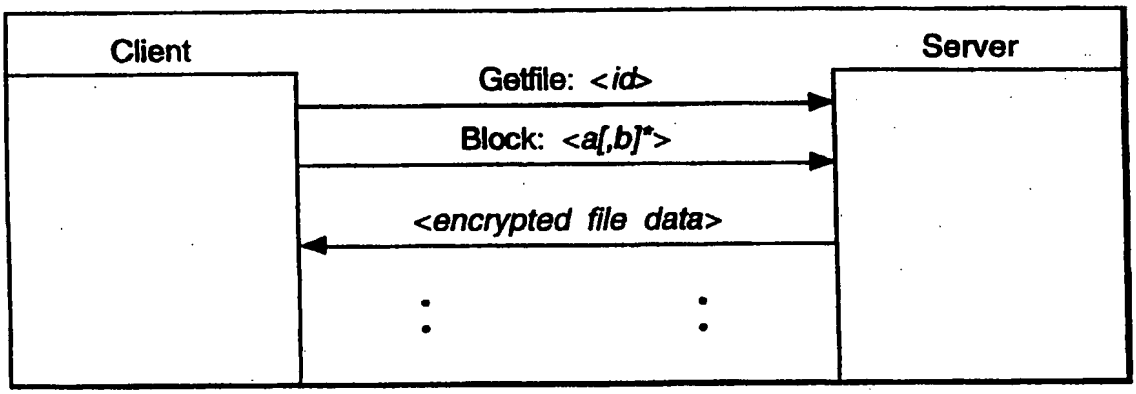
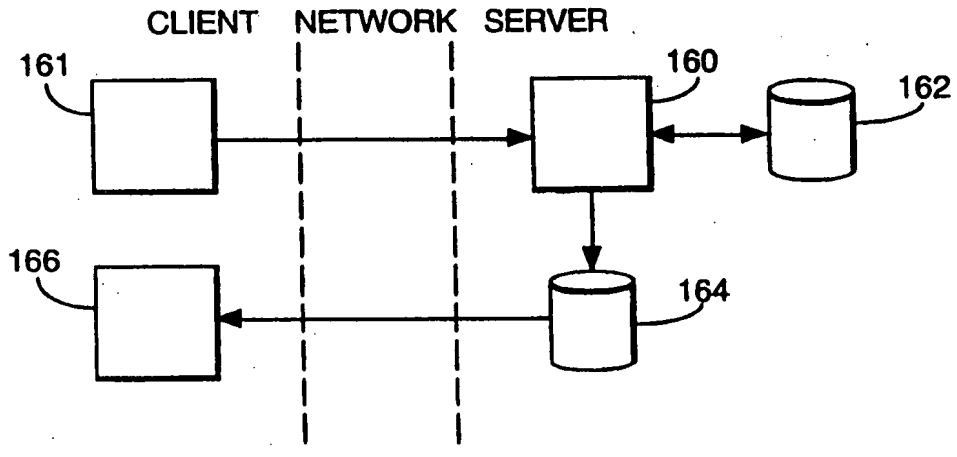


Fig.17.



INTERNATIONAL SEARCH REPORT

Interna ual Application No
PCT/GB 97/01755

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L29/06 G06F1/00 H04L12/58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 373 559 A (KAUFMAN CHARLES W ET AL) 13 December 1994	1-5,7,8, 16-18, 22,23
Y	see column 1, line 8-34 see column 2, line 61 - column 3, line 19 see column 7, line 39 - column 8, line 39 see column 10, line 53-58 see column 11, line 58 - column 13, line 17	6,9,10, 13,24

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 May 1998	0 3. 06. 98

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Dupuis, H

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INTERNATIONAL SEARCH REPORT

Interna nal Application No
PCT/GB 97/01755

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	STAINOV R: "DATENSICHERHEIT IM INTERNET: PRINZIPIEN, MOEGLICHKEITEN UND GRENZEN" NTZ NACHRICHTENTECHNISCHE ZEITSCHRIFT, vol. 49, no. 8, 1 January 1996, pages 32-34, 36 - 38, 40, XP000623476	1,2,7, 14,22, 27,28
Y	see page 36, middle column, line 24 - right-hand column, line 10	8,15, 23-25
A	see page 37, right-hand column, line 18 - page 38, left-hand column, line 34; figure 4	4,5

X	EP 0 715 247 A (XEROX CORP) 5 June 1996	29-36, 38,51,54
Y	see page 2, column 1-14 see column 3, line 52 - column 4, line 20 see column 7, line 40-53 see page 8; table 2 see page 11, line 15 - page 12, line 45 see page 15, column 39 - page 17, line 26 see page 19, line 55-58 see page 21, line 2-5 see page 23, line 41 - page 24, line 1	37

X	GB 2 047 506 A (ATALLA TECHNOVATIONS) 26 November 1980 see page 1, line 73-104 see page 3, line 117 - page 7, column 28	29,30, 34,35,41

X	US 5 642 420 A (KURODA YASUTSUGU ET AL) 24 June 1997	29,35,41
Y	see column 4, line 56 - column 7, line 27 see column 9, line 17-23	55

X	US 5 475 757 A (KELLY JOSEPH P) 12 December 1995 see abstract see column 5, line 21-55 see column 9, line 45 - column 10, line 49	29,35,41

X	US 5 548 646 A (AZIZ ASHAR ET AL) 20 August 1996	42
A	see column 3, line 20-29 see column 3, line 65 - column 6, line 11; table see column 12, line 3 - column 13, line 37	44,45,50

X	"OS/2 OFFICE: DELAYED DELIVERY FOR MAIL ITEMS" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 34, no. 9, 1 February 1992, pages 381-382, XP000301917	51,54
Y	see the whole document	55

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INTERNATIONAL SEARCH REPORT

Interna .al Application No
PCT/GB 97/01755

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 319 705 A (HALTER BERNARD J ET AL) 7 June 1994	37
A	see column 5, line 28 - column 6, line 16	52,53

Y	EP 0 695 985 A (MICROSOFT CORP) 7 February 1996	8,23-25
A	see page 2, right-hand column, line 18-38 see column 2, line 26-47 see column 3, line 15-55 see column 6, line 8 - column 8, line 40; figure 3 see column 9, line 53-57	1

Y	EP 0 693 836 A (SUN MICROSYSTEMS INC) 24 January 1996 see column 17, line 49 - column 18, line 11	15

Y	JOHNSON J T: "SIGN ON AND BE SAFE IBM'S NETWORK SECURITY PROGRAM (NETSP)" DATA COMMUNICATIONS, vol. 24, no. 1, 1 January 1995, page 122, 124 XP000480828 see page 122, middle column, line 27 - page 124, middle column, line 4	24

Y	"METHOD OF AUTHENTICATED PASSWORD OR PASSPHRASE CHANGING" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 36, no. 11, 1 November 1993, pages 285-289, XP000424864 see page 287	6

A	US 5 497 421 A (KAUFMAN CHARLES W ET AL) 5 March 1996 see column 2, line 65 - column 3, line 10 see column 4, line 15 - column 6, line 50	1-5,20, 21

Y	FR 2 741 465 A (BULL SA) 23 May 1997	9,10,13
A	see page 1, line 4-5 see page 1, line 34 - page 2, line 12 see page 3, line 3-37 see page 6, line 1 - page 7, line 9 see page 11, line 35 - page 12, line 8	1,2,4,5, 7,8,14, 27

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INTERNATIONAL SEARCH REPORT

Inte...ational application No.
PCT/GB 97/01755

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-28

Method and apparatus for authenticating users.

2. Claims: 29-41

Method and apparatus for transferring a file via a server using two encryption keys.

3. Claims: 42-50

Method and apparatus for transferring a file between two terminals using a transfer type transmitted by a server.

4. Claims: 51-55

Method and apparatus for transferring data via a server using a delay indicator specified by the sender.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inten. ..onal Application No
PCT/GB 97/01755

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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GB 2047506 A	26-11-80	US 4268715 A	19-05-81
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. ional Application No
PCT/GB 97/01755

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP 0774707 A	21-05-97